Enhancement of the Quality in PET Brain Images Using *AutoGANcoder* Algorithms

Reyhane Sadat Razavi Satvati

Faculty of Energy Engineering, Sharif University of Technology of Iran (SUT), Tehran, Iran

Naser Vosoughi *

Faculty of Energy Engineering, Sharif University of Technology of Iran (SUT), Tehran, Iran

Pardis Ghafarian

Chronic Respiratory Diseases Research Center, National Research Institute of Tuberculosis and Lung Diseases (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran

PET / CT and Cyclotron Center, Masih Daneshvari Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Ali Jafari

Faculty of Engineering, IRIB University, Tehran, Iran

Abstract:

Nowadays, disease diagnosis using Positron Emission Tomography (PET) is on the rise. The quality of images produced by PET scanners plays a significant role in accurate diagnosis. However, these images often contain substantial noise due to photon attenuation and scatter. Therefore, PET images require attenuation correction (AC) and scatter correction (SC) to provide precise metabolic information about the patient's organs. CT-based correction methods expose the patient to significant ionizing radiation. The aim of this research is to enhance the output image quality of PET scans using Generative Adversarial Networks (GAN), a revolutionary approach in modern medical imaging, to reduce errors and patient exposure to radiation. In this study, 92 epilepsy patients with an average weight of 72.15 kg were scanned. These patients underwent brain imaging after being injected with an average activity of 347.13 MBq of FDG radiotracer over a duration of 1200 seconds. These brain images served as the dataset for our designed algorithm, a GAN-based model. Image quality metrics such as SSIM, PSNR, MSE, FID, and LPIPS were measured. Our AutoGANcoder algorithm, a unique combination of a GAN and an advanced autoencoder, demonstrated that it significantly improved PET imaging quality. When compared to other algorithms, the results show that the AutoGANcoder model is a promising choice for improving brain PET image quality.

Keywords:

Positron Emission Tomography, Generative adversarial network, brain images, Deep learning.